Atmos. Chem. Phys. Discuss., 9, C10315–C10318, 2010
www.atmos-chem-phys-discuss.net/9/C10315/2010/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Marine boundary layer over the subtropical southeast Pacific during VOCALS-REx – Part 2: Synoptic variability" *by* D. A. Rahn and R. D. Garreaud

Anonymous Referee #1

Received and published: 1 February 2010

This paper provides good documentation of the marine boundary layer depth in the VOCALS area as simulated by WRF simulations and compared with in situ and remote observations. It examines the processes that control the modeled boundary layer depth and what factors may be most important in the different regions of the VOCALS study area. A major conclusion is that the advective term may dominate the observed local temporal variations of the inversion height. This work provides a better understanding of how the boundary layer depth is controlled by the large-scale flow in this area. But at the same time there may be differences in how well the model represents the inversion height closer to the coast than at locations farther west. The importance of these coastal biases was not fully discussed with respect to the inversion height budget

analysis. Despite this shortcoming, the paper is generally well written and worthy of publication.

Major Issue:

The analysis is based on the WRF simulations. A comparison with the observations indicates a low bias in the model simulations of the boundary layer depth near the coast in some cases (See Fig. 3). But how might this bias affect the advective terms calculated? Are possible biases in the advective terms significant and in what areas of the domain are they important? This is an important point for consideration, since a major conclusion of the study is that there is close relationship between the inversion height variations and the advective terms in some areas of the study domain. From 70 to 75 W the bias in the inversion height gradient (see Fig. 3) can be as large as 500m/500 km, which would bias the E-W component of the advective term by 1-5 mm/s for zonal wind variations of 1-5 m/s in this area of the domain. This point needs to be addressed in general and particularly in the text where explicit statements that the WRF inversion height bias may not affect the results. This would only be true if the bias were constant over the entire domain. A particular aspect of this bias issue is that may affect the level of confidence that the authors have in the conceptual model they propose in Section 4. (See middle panel of Fig. 14 for the Decreasing case).

Minor Editing and Technical Points:

Page 26064; Abstract: Lines 13-16: Rewrite this sentence to remove the contradiction that results by stating that each term (LS advection, vertical velocity, and entrainment rate) is explicitly calculated, although the entrainment term is not.

Page 266065; line 5: Add “The” before depth.

Page 26065; line 8: Lilly (1968) includes no discussion of the advective terms. The mixed layer formulation described in Schubert et al (1979) was the first treatment that included and discussed the advective terms in the Lilly-type model

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Page 26066; line 3: Use “analyses” in place of “analysis”. Page 26066; line 8: Remove extra words in this sentence. “Observed datasets” e.g. is redundant.

Page 26068; line 10: Is the weak vertical motion up or down? The sign his difficult to discern from the color scheme used. Also since the individual panels in this figure are very small and have to be enlarged to show the dates on the x-scale.

Page 26069; line 9: Add “an” before “inconsistent variation” or edit to refer to this as either random or incoherent variations. One difficulty that should be discussed is that the model bias of the inversion height shows an E-W variability that may affect the advection terms in the analysis in some areas of the domain.

Page 26069; line 24. Again Lilly (1968) may not be the most appropriate citation for Eq. 1, since the advection term was not included in the Lilly formulation.

Page 26070. It is unclear how the MBL depth is defined from the model grid-point values.

Page 26070; line 7. Is the nine-point smoother a spatial smoothing? If so, it should be stated along with the functional form of the smoothing.

Page 26070; line 14. Since the residual is indicated to be more than just entrainment, indicate what factors might be part of this residual in addition to the entrainment. Not clear from Eq. 1 what these factors might be.

Page 260074. An alternate title for Section 3.3might be “Case Studies”.

Page 26075, lines 10-11: Unclear sentence. Remove extra words as needed to clarify.

Pages 26075-26076: Section 4 can be shortened and focused to improve readability.

Page 26077; lines 17-18. Again the statement that the simulated MBL height tended to be lower than that observed is misleading since the bias appears to have an east-west variation.

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Figure 4. Define dashed line in panel b. These appear to be linear fits to the points presented on the scatter plots.

Figures 10-12 and other horizontal maps. It would be helpful to mark point Omega on these (and possibly other) horizontal contour maps.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 26063, 2009.